

NOTE ON MAPS ILLUSTRATING EXPLORATIONS IN CHINESE
TURKESTAN AND KANSU.*

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THE maps published herewith are intended to illustrate the explorations which were carried on by me during the years 1906-08 in Chinese Turkestan and westernmost Kansu under the orders of the Indian Government, and with the special assistance of the Survey of India Department, and of which a preliminary account has been furnished by me in the *Geographical Journal* for July and September, 1909. They comprise a general map (I.) of the area over which the explorations of those years extended, between the approximate longitudes 75° to 101° E., on the natural scale of 1 : 3,000,000; and two maps, on the scale of 1 : 1,000,000, showing important mountain regions within that area, viz. portions of the Kun-lun range south of the Karghalik-Khotan-Keriya line (II.), and portions of the Western and Central Nan-shan between the longitudes of Yü-mén-hsien and Kan-chou (III.). The general map contains also insets showing, on the natural scale of 1 : 1,000,000, the geographically and archæologically interesting region through which the remains of the ancient Chinese frontier wall extend, from the desert west of Tun-huang to the vicinity of Yü-mén-hsien (A, B); as well as the oases of Chira, Gu-lakhma, and Domoko (C), on a scale 1 : 500,000 between Khotan and Keriya, which along with the adjacent desert tracts may claim a similar interest.

These maps have been reduced from the map in 94 sheets, drawn on the scale of 4 miles to 1 inch or 1 : 253,440, and each extending over one degree of latitude and longitude, respectively, in which the Trigonometrical Survey Office, Dehra Dun, under the direction of Colonel S. G. Burrard, R.E., F.R.S., has embodied the results of the surveys effected by my topographical assistants and myself. These sheets, at present in course of reproduction by heliozincography at the Trigonometrical Survey Office, Dehra Dun, are intended for publication, in the form of an atlas, with my detailed Report on the scientific results of my journey. They will also be utilized by the Survey of India for the preparation of its "Trans-frontier" degree sheets of those regions. At the time when the present reduced-scale maps were being drawn the sheets of the 4 miles to 1 inch map were available for reference in outline proofs only, not showing as yet the hill shading. The latter along with certain other details had, therefore, to be supplemented from the tracings retained by me of the original plane-table drawings. In addition, the surveys effected on my previous journey in 1900-01, and already shown* in the maps attached to my paper in the *Geographical Journal* for December, 1902, and to my *Ancient Khotan* (Oxford, 1907), have been utilized for filling in certain portions of the ground shown in the extreme west of the general map as well as small areas in Map II., re-visited in 1906-08, but no

* Maps, p. 280

re-surveyed. The only features shown in the present maps and taken from sources other than the original surveys of my journeys are certain portions of the Tarim, Kashgar, and Charchan river courses, which for the sake of clearness were added (in broken outlines) from the maps illustrating Dr. Sven Hedin's explorations, and a number of triangulated points in the mountains south of Keriya which were inserted by the Trigonometrical Survey Office from its early Ladak triangulation records and Captain Deasy's observations of 1898-99.

The map sheets prepared by the Trigonometrical Survey Office and here reproduced on reduced scales are based principally upon the plane-table surveys carried on continuously in the course of my travels by my topographical assistants and myself. These were supplemented by astronomical observations for latitude and by triangulation as described further on. Rai Sahib Ram Singh, Sub-Assistant Superintendent, Survey of India, worked with me from the time when we entered Chinese territory in May, 1906, on the Taghdumbash Pamir, down to September, 1907, when he had to be invalided to India from An-hsi. His place was then taken by Sub-Assistant Superintendent Rai Bahadur Lal Singh, who shared in my subsequent explorations until we re-crossed the Chinese frontier in October, 1908, on the Kara-koram. Both, before joining me, had a record of many years' surveying experience over wide and varied ground, Rai Ram Singh having previously worked in Chinese Turkestan and Tibet with the expeditions of Captain Deasy, Majors Ryder and Rawling, and myself, while Rai Bahadur Lal Singh's twenty years' surveying labours had extended practically over the whole of the Trans-frontier regions within the range of Indian interests from the Yemen to China proper. For the trained skill, devoted industry, and unflagging zeal which they brought to bear upon their tasks, carried on often under extremely trying conditions, I feel bound once more to record here my high appreciation.

The plane-table work was done throughout on the scale of 4 miles to 1 inch, and in accordance with the methods employed by the Survey of India for "reconnaissance survey" work. On mountainous ground no efforts were spared to establish plane-table stations on commanding heights above passes and route lines, elevations up to close on 20,000 feet being climbed by us in the Kun-lun for this purpose. In the desert plains of the Tarim basin, where it was often difficult to fix positions by intersections or triangles, the exact measurement of the marching distances, invariably made with a cyclometer, proved particularly useful in traversing.

For the purpose of securing points to check the plane-table traverses, astronomical observations for latitude were made by my assistants with a 6-inch transit theodolite wherever the available time and the weather conditions permitted of them. A list printed below shows those 72 points for which the computed latitudes were utilized by the Trigonometrical Survey Office in the compilation of the map sheets. In addition to these use was made also of the latitude observations which had been obtained

in the course of my journey of 1900-01 for numerous positions in the western and south-western portions of Chinese Turkestan then surveyed.

The work of securing these observations was beset with serious difficulties, both on account of the climatic conditions prevailing and the rapidity of movement necessitated by considerations for my other scientific tasks and by the wide extent of the area to be covered. In and along the deserts of the Tarim basin and of the Su-lo-ho drainage the frequent periods of dust-haze proved as great a trouble in this respect as the cloudy and rainy weather encountered during most of our work in the Nan-shan ranges. The rapid succession of daily marches, often over 25 miles in length, may be gauged from the fact that during the two years and four months actually spent on Chinese soil there were 488 shifts of camp, the aggregate of the marching distances for the same period amounting in my own case to close on 8300 miles. In addition, it must be remembered that what time could be spared for prolonged halts had to be devoted mainly to exacting archæological labours, generally at desert sites. Observations for longitudes were practically precluded by such conditions of travel.

In order to extend the area covered by our surveys, I detached the topographical assistant from my own party for independent work whenever the available routes, means of transport, etc., and considerations of other tasks allowed this. During these periods of detachment, which on occasions extended to over two months, I carried on the plane-table work along my own routes myself. The comparison of the positions indicated by our traverses at the points where the surveyor's and my own route-lines crossed or joined, furnished a useful means of checking the results. Wherever we moved together, the work on the plane-table was done under my direct supervision and with my assistance. The record of local names along our common routes was invariably effected by myself. For routes followed only by my assistant, I used every effort to check and correct the record of local names brought back by him through the independent examination of natives acquainted with the ground.

In this connection it may be stated that in the transcription of Turki and Iranian names I have followed the system of phonetic transliteration approved by the International Congress of Orientalists, and used, in a simplified form, for Indian Government publications. No use, however, has been made of diacritical marks. In each case I endeavoured to record the form of the name as actually pronounced by the local inhabitants, refraining from any attempt to spell the name in accordance with its correct Turki etymology. I am aware that this method of record has led in some instances to obvious inconsistencies; but I considered it the safest in the case of a geographical student like myself, who, though an Orientalist and familiar with the spoken language of Eastern Turkestan, do not profess to be a Turkologist. In the case of Chinese local names, I took the precaution of having them written down on the spot also in

Chinese characters by Chiang-ssü-yieh, my Chinese literatus. For the subsequent transliteration of the names thus recorded, according to the officially adopted Wade system, I am indebted to the kind help of Mr. L. Giles, of the British Museum.

For the purpose of obtaining a framework of triangulation for at least portions of the ground surveyed, bases were measured by Rai Sahib Ram Singh, first in the Tash-kurghan valley below the Taghdumbash Pamir, and subsequently in the outer hills of the Kun-lun, south of Keriya. These were connected with trigonometrical points accepted by the Survey of India and originally determined by the Pamir Boundary Commission and Captain Deasy, respectively. The very inaccessible character of the ground encountered in the Tash-kurghan river valley lower down prevented, in the first instance, any further extension of the triangles. But the work started about Polur proved very successful, and enabled Rai Sahib Ram Singh to extend a series of triangles in direct connection with the Indian triangulation system eastwards along the northernmost range of the Kun-lun to a point well beyond the Charchan river, *i.e.* from circ. $81^{\circ} 40'$ to $86^{\circ} 48'$ E. long. This triangulation was carried out in the late autumn (of 1906), when, as usual, the atmospheric conditions of this region were better than at other seasons. But the great cold then prevailing at the high elevations where the triangulation stations had to be established, severely taxed the surveyor's physical endurance, and renders the success achieved by him all the more creditable.

It was hoped by me at one time to carry this triangulation right through to Tun-huang and the westernmost Nan-shan. But the rheumatic illness contracted by Rai Sahib Ram Singh in the course of the operations just referred to, and other reasons obliged me to keep my whole party with me when travelling in the winter of 1907 from the Lop-nor region to Tun-huang, and the desert route then followed precluded any attempt at further triangulation. Misfortune of another sort—damage to a theodolite level, which could not be repaired at the time—prevented Rai Bahadur Lal Singh, in the spring of 1908, from effecting the intended triangulation along the southern main Tien-shan range from the neighbourhood of Aksu westwards to Kashgar, for which I had deputed him. We were, however, more successful in the rugged high range of the Kun-lun, near the previously unexplored headwaters of the Khotan river, where a number of elevated stations could be connected by triangulation with the Ladak series of the Indian Trigonometrical Survey. A chart of observed bases and triangles, along with a complete list of trigonometrically fixed points, will be published with the maps on the scale of 1 : 253,440.

Apart from heights measured by theodolite vertical angles in the course of triangulation, elevations were obtained from observations of two Watkin mountain aneroids of the Survey Department, which were checked at regular intervals with mercurial barometers and, as judged by this test, preserved a very uniform rate of index error. Neither of the mercurial

barometers survived the journey; the second, however, remained in working condition to within two months of the conclusion of exploratory work. In addition hypsometrical observations were made by me with two boiling-point thermometers, which, along with a mountain aneroid and half-chronometer, had been kindly lent to me by the Royal Geographical Society's Council. Clinometrical readings to prominent heights were regularly taken in the course of plane-table work on mountainous ground, care being taken on high elevations to obtain clinometer readings with preference from points where the use of the mercurial barometer was practicable for observation of absolute heights. The clinometric heights recorded in Map III. for the Nan-shan are based largely on such observations.

According to information kindly furnished to me by Mr. J. Eccles, M.A., Superintendent, Survey of India, who, in succession to Captain H. H. Turner, R.E., supervised the compilation of the original map sheets from the above materials, the representation of the area south of the line Kashgar—Yarkand—Khotan—Charchan is based on the trigonometrical points secured by Captain Deasy's work and on my journeys of 1900–01 and 1906–08. As regards the north-western portion of the area shown in Map I., the compilation rests on the position previously determined for Kashgar and that newly obtained for Aksu by our plane-table traverses from Khotan, Kashgar, and Yarkand. The values given by these three traverses differed so slightly from each other that it was decided to adopt their mean, though this implies, for the position of Aksu, a considerable shift in longitude to the east as compared with the position accepted in former maps. In compiling the rest of the area, it was found that the plane-table traverse between the easternmost point fixed on a trigonometrical base and Kan-chou required considerable correction in longitude, for overestimated measurement of direct distances (here mainly on a line from west to east), in order to agree with the longitude of Kan-chou, as hitherto accepted by the Survey Department. Another plane-table traverse made from Keriya to An-hsi to close the circuit gave a somewhat more satisfactory result. It was decided to retain the old longitude of Kan-chou and to adjust the intervening topography accordingly, with due regard to the astronomically determined latitudes.

In conclusion, I wish to express here my sense of deep obligation to the Survey of India Department, which, under Colonel F. B. Longe, R.E., Surveyor-General, by its generous help in the matter of trained assistants, instruments, and money grants rendered possible the execution of my geographical tasks on the scale above recorded. I owe much gratitude in particular to Colonel S. G. Burrard, R.E., F.R.S., Officiating Surveyor-General, who, as Superintendent, Trigonometrical Surveys, by his unfailing interest and experienced advice greatly facilitated both the work in the field and the elaboration of its results in his office.

LIST OF ASTRONOMICALLY OBSERVED LATITUDES.

Camp.	Latitude.	Place.	Camp.	Latitude.	Place.
	° ' "			° ' "	
1	37 51 27	Chushman.	197	39 53 35	Temple of Ch'ing-tsao-an-tzü.
5	37 50 40	Udurghuk.	200	39 48 16	Chia-yü-kuan, outside east gate.
7	38 5 42	Toile-bulung.	201	39 45 6	Su-chou, Chiu-chüan temple outside east gate.
11	38 30 42	Karghai-aghzi.	203	39 25 27	Chin-fo-ssü, garden 1 mile to south of east gate.
12	38 40 9	Ighiz-yar.	207	38 59 54	Ta-pén-ko, gold-miners' camp.
19	38 23 59	Chini-bagh, Yarkand.	211	38 54 54	Spring in side valley of Pei-ta-ho.
21	38 28 17	Bagh-jigda (Beg's house).	223	38 38 31	Camp on river-bank below Fêng-ta-fan.
24	37 24 1	Kök-yar.	227	39 9 24	Sha-ho-kou, river - bank outside east gate.
26	37 3 20	Kosh-yüz-öghil.	228	38 55 41	Kan-chou, temple outside S.E. corner of city.
42	36 26 50	Pusha (Shamsheh Mazar).	231	39 20 3	Chien-ch'uan-tzü.
44	36 30 4	Tashte-öghil, Kurat Jilga.	237	40 5 34	Chih-chin-sé, rest-house near N.W. end of village.
46	36 39 5	Camp below Ashpak.	245	41 33 40	Ma-lien-ching-tzü.
49	36 15 46	Foot of Kashkul glacier.	248	42 2 50	K'u-shui.
57	36 21 8	Jigatal, Kochkar-bashi.	252	42 48 44	Hami, garden on west bank of river.
60	37 1 12	Kotaz Langar, Sampula.	259	43 6 33	Taranchi.
63	36 34 50	Toghrak Langar.	262	43 29 10	Tung-yen-tzü.
68	36 21 49	Sokterek.	265	42 51 56	Pichan, Beg's house outside west gate.
69	36 24 41	Camp near Δ station above Achchan.	267	42 39 7	Chong-Hassar ruin.
72	36 30 58	Kara-bulak.	274	42 55 39	Turfan, S.E. quarter of Chinese town.
75	36 36 21	Malghun.	287	41 44 32	Korla, main bazar.
89	36 36 29	Kuchkach-bulaki.	288	41 55 48	Ruined site of Ming-oi, Shikchin.
99	37 14 5	Ile-dong, Kapa.	295	41 14 38	Camp Jigda-sala.
99	37 14 53	Gold-pits, Kapa.	299	41 14 39	Inchike-gumbaz (ruined tombs).
103	38 8 21	Charchan Bazar.	309	41 42 58	Kuchar city (near Yamén).
106	37 52 24	Kara-tash Sai.	322	39 18 19	Dead tamarisk cone 4 miles N. of Camp 323, ancient delta of Keriya river.
110	38 20 2	Camp on Yol-Sai.	327	38 41 43	Camp on new Keriya river-bed.
124	40 31 14	Stupa of ruined site, "Lou-lan."	330	38 23 13	Tonguz-baste, shepherds' hut.
125	40 34 30	Camp near temple ruin, "Lou-lan."	350	37 14 18	Ulugh-mazar.
147	39 59 31	Panja springs.	367	38 3 5	Camp Malghun on Kara-kash river.
152	40 29 41	Besh-toghrak well.	369	38 27 12	Mazar-tagh, left river-bank below hill.
154	40 19 35	Toghrak-bulak.	371	39 0 4	Camp Ayak östang.
159	40 8 9	Tun-huang town, garden outside south gate.			
164	40 25 45	Ruined watch-tower, T. XXVIII., of ancient Limes N.E. of Tun-huang.			
168	39 54 39	Nan-hu, central hamlet.			
172	40 8 16	Springs south of ruined watch-tower, T. VI. b.			
178	40 2 37	Chien-fo-tong; monks' residence near south end of cave temples.			
181	40 22 7	Kua-chou-k'ou.			
182	40 31 38	An-hsi, temple outside west gate.			
184	40 19 40	Chiao-tzü, large temple within walls.			
188	39 49 3	Camp $\frac{1}{2}$ mile north of Shih-pao-ch'eng.			
193	39 51 45	Ch'ang-ma, temple within main village.			

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